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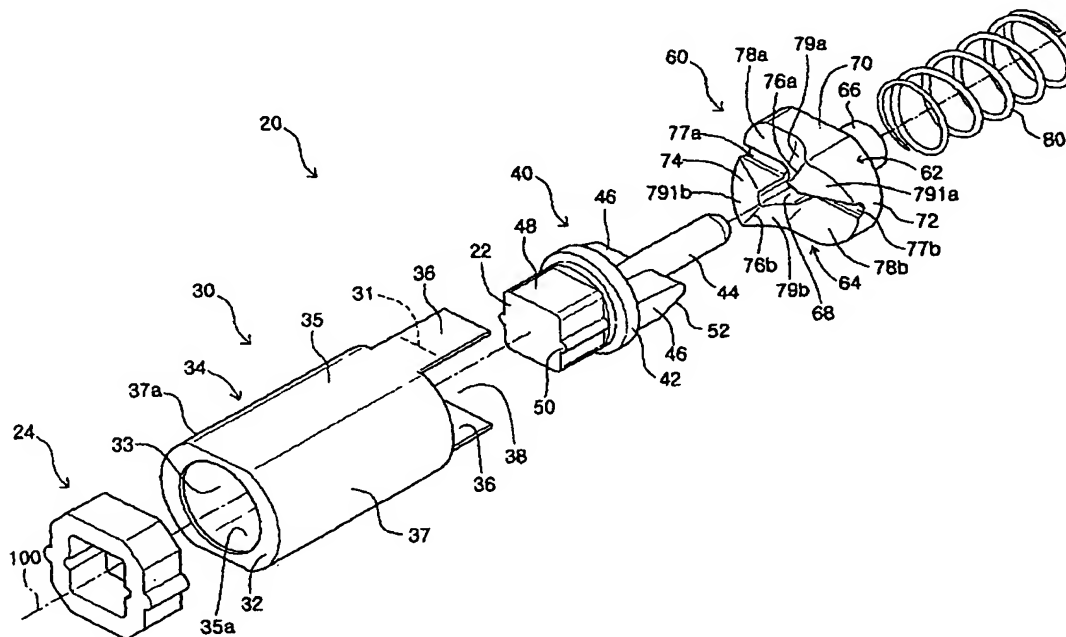
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(54) Title: HINGE DEVICE



(57) Abstract: The hinge device includes a housing (30), a cam (60), a cam follower (40) to interact with the cam, and a resilient member (80). The housing contains the cam, cam follower and resilient member. The cam moves linearly, and the cam follower rotates. The cam has a peak (76), a valley (77), and a straight line section (78) in which the cam follower holds its position.

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HINGE DEVICE

Technical Field

5 The present invention relates generally to a hinge device, and more particularly, to a hinge device for coupling two members in a device such as a portable radiotelephone comprising two members that can be moved to folded and unfolded positions of the device with respect to each other about an axis, if so desired.

Background Art

15 A portable device such as a portable folder-type radiotelephone includes two members coupled to each other through a hinge device. Usually, one member is provided with a keypad with buttons, and the other member is provided with a liquid crystal display. When the radiotelephone is not in use, the two members are moved to a folded position so that the keypad and the liquid crystal display face each other. Alternatively, when the radiotelephone is in use, the keypad and the liquid crystal display are moved to an unfolded position so that the keypad and display are exposed. The hinge device allows the two members to be coupled to each other and to be smoothly moved to the folded and unfolded positions.

20 The conventional radiotelephone is usually unfolded or opened only at a single angle. This is because the conventional hinge device has been designed to maintain a stationary state only at a single unfolded angle. However, as recent radiotelephones have a variety of functions, there is inconvenience in using the radiotelephone only at a predetermined, unfolded angle. Therefore, there exists a need for a hinge device that allows a radiotelephone to be unfolded and used at different angles.

Summary of the Invention

30 An object of the present invention is to provide a hinge device for allowing a

radiotelephone to be unfolded and used at different angles by improving a conventional hinge device.

Another object of the present invention is to provide a hinge device that automatically rotates in a certain range of angle, is stopped at an arbitrary position in
5 another range of angle, and is fixed at the other angle.

According to one aspect of the present invention, there is provided a hinge device for coupling a first unit and a second unit which can be relatively rotated with respect to each other to a folded or unfolded position, comprising a cam member with a cam; a cam follower member provided with cam followers interacting with the cam of
10 the cam member; and a resilient member for exerting a force on any one of the cam member and the cam follower member so that the cam followers of the cam follower member can interact with the cam of the cam member. One of the cam member and the cam follower member is mounted in the first unit to linearly move with respect to the first unit and the other is coupled to the second unit to rotate about a rotation axis
15 with respect to the linearly moving member. The cam of the cam member includes a peak for causing the linearly moving member of the cam member and the cam follower member to be moved farthest away from the other rotating member, two slant surfaces sloping downward from and on both sides of each of the peak, and a linear section that is connected to one of the two slant surfaces and holds the linearly moving member in a
20 predetermined position.

The end of the linear section may be provided with a groove forming a valley into which the cam follower member is inserted.

The hinge device may further comprise a housing that is fixed to the first unit and contains the linearly moving member therein.

25 A guide rod extending along the rotation axis may be fixed to one of the cam member and the cam follower member, and a guide hole into which the guide rod is inserted may be formed on the other of the cam member and the cam follower member, thereby guiding the relative motion between the cam member and the cam follower member.

30 The rotating member of the cam member and the cam follower member may

include an extension shaft protruding toward the exterior of the housing, and the hinge device may further comprise a coupling member coupled to the extension shaft and the second unit.

5 The peak may be provided with grooves into which the cam follower member can be inserted.

A groove into which the cam follower member can be inserted may be provided at a portion where the one of the slant surfaces and the linear section meet each other.

The linear section may be provided with a plurality of grooves into which the cam follower member can be inserted.

10

Brief Description of the Drawings

Preferred embodiments of the present invention will be described with reference to the accompanying drawings so that those skilled in the art can clearly understand the objects and features of the present invention.

15

FIG. 1 is a perspective view of a folder-type radiotelephone comprising a hinge device according to an embodiment of the present invention, with a first case unit and a second case unit disassembled and with a disassembled hinge device shown on an enlarged scale;

20

FIG. 2 is an exploded perspective view of the hinge device of FIG. 1;

FIG. 3 shows a deployed cam surface of the hinge device of FIG. 1;

FIGS. 4 (a) to (c) are views showing sequential operations of the hinge device, with a housing cut therethrough to show the interior of the housing;

25

FIG. 5 is a side view showing folded and unfolded states of the radiotelephone of FIG. 1;

FIG. 6 is a view showing a deployed cam surface in a second embodiment of a cam member of the hinge device of FIG. 1;

FIG. 7 is a view showing a deployed cam surface in a third embodiment of the cam member of the hinge device of FIG. 1; and

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FIG. 8 is a view showing a deployed cam surface in a fourth embodiment of the

cam member of the hinge device of FIG. 1.

Detailed Description of the Embodiments

5 Referring to FIG. 1, a portable folder-type radiotelephone 10 comprises a first case unit 12 provided with a keypad, and a second case unit 14 provided with a liquid crystal display. Hinge devices 20 are mounted at both sides of a coupling portion between the first case unit 12 and the second case unit 14. The hinge devices 20 are inserted into mounting holes of the first case unit 12 and the second case unit 14 is then
10 coupled to the hinge devices 20. The shape and size of the mounting holes generally correspond to those of the hinge devices 20. This is to prevent the hinge devices 20 from escaping from the mounting holes and to cause the hinge devices to be fixed to and not to rotate with respect to the first case unit 12.

Each of the hinge devices 20 includes a rotatable extension shaft 22 that
15 protrudes toward the second case unit 14. A coupling member 24 is fitted over the extension shaft 22. The coupling member 24 includes an engaging surface 26. The second case unit 14 is provided with coupling holes 28 into which the coupling members 24 of the hinge devices are fitted. Each of the coupling holes 28 has an engaging surface interacting with the engaging surface 26. Alternatively, the second
20 case unit may be provided with the extension shaft, whereas each of the hinge devices may be provided with the coupling hole. Further, the extension shaft 22 may be engaged directly to the second case unit 14 without the coupling member 24.

Referring to FIG. 2, each of the hinge devices 20 comprises a housing 30, and a
cam follower member 40, a cam member 60, a resilient member 80 and the coupling
25 member 24 which are sequentially accommodated in the housing 30.

The housing 30 comprises an elongated can. A longitudinal centerline of the housing 30 defines a rotation axis 100 of the hinge device 20. The housing 30 comprises an end wall 32 formed at one end thereof, a sidewall 34 formed to extend from the end wall 32, and extension protrusions 36 extending from portions of the
30 sidewall 34. The other end 38 opposite to the end with the end wall 32 formed is open.

The end wall 32 is provided with a shaft hole 33. The sidewall 34 includes opposite flat walls 35, 35a and opposite arc-shaped walls 37, 37a. When the housing is fitted into the case unit of the radiotelephone, the flat walls 35, 35a function as keys for preventing the rotation of the hinge device. In addition, as will be described later, the flat walls also function to prevent rotation of the cam member 60 accommodated in the housing. The extension protrusions 36 are formed to extend from the opposite flat walls 35, 35a. After the cam follower member 40, the cam member 60 and the resilient member 80, which will be described later, are inserted into the housing 30, the protrusions 40 are bent to cover the open end 38.

However, the present invention is not limited to such a method of covering the open end. As for a method of covering the open end 38 to prevent the resilient member 80 from protruding outward, methods other than bending the extension protrusions 36 may be used. Without additional protrusions, the open end may be covered by deforming a wall portion on the side of the open end of the housing after the inner parts are inserted into the housing. In addition, a cap may be manufactured and then fixed to the open end to be covered with the cap after the parts are inserted into the housing.

It is preferred that the housing 30 be formed of a metallic material such as a brass plate and be manufactured by using a deep drawing method. Alternatively, the housing may be formed by injection molding plastic resin material.

The cam follower member 40 includes a disk-shaped support 42, the extension shaft 22 extending from the support 42 along the rotation axis 100, a guide rod 44 extending from the support 42 in a direction opposite to the extension shaft 22 along the rotation axis 100, and cam follower protrusions 46 formed at both sides of the guide rod 44.

The extension shaft 22 includes engaging surfaces 48 and engaging protrusions 50 formed on the engaging surfaces 48. In a case where there is no coupling member 24, the engaging surfaces 48 and the engaging protrusions 50 are engaged directly with the case unit. The guide rod 44 is an elongated and slender cylindrical rod extending from the center of the support 42. The two cam follower protrusions 46 are formed to

be in close contact with the sides of the guide rod 44. The cam follower protrusions 46 extend together with the guide rod 44 in a direction parallel to the rotation axis 100 by a length shorter than that of the guide rod 44. The two cam follower protrusions 46 are symmetrically disposed with respect to the rotation axis 100 of the hinge device 20.

5 The two cam follower protrusions 46 form cam followers. The cam followers refer to portions interacting with a cam surface to be described later. Each of the cam follower protrusions 46 is provided with a slant surface 52 by which the thickness of the cam follower protrusion is reduced toward its tip end, which is rounded. It can be understood by those skilled in the art that the thickness, gradient and curvature of the tip

10 end of the cam follower protrusion may be determined to interact with stopping grooves formed on the cam surface to be described later. Of course, the configuration of the cam followers is not limited to that of the aforementioned cam follower protrusions 46. The cam followers may comprise pillars separated from the guide rod.

The cam follower member 40 is inserted through the open end 38 of the housing 30. The cam follower member 40 can rotate about the rotation axis 100 within the housing 30. The extension shaft 22 of the cam follower member 40 protrudes through the shaft hole 33 of the housing 30.

The coupling member 24 is fitted over the extension shaft 22. The coupling member 24 is provided for the purpose of increasing the distance from the rotation axis 100 to the engaging surfaces, the area of the engaging surfaces and the size of the engaging protrusions, thereby ensuring transmission of the rotation of the cam follower member 40 to the case unit of the radiotelephone. Depending on the configuration of the case unit, there may be no need for a coupling member.

The cam member 60 includes a sidewall 62, a cam portion 64 formed at one side of the cam member 60 facing the cam follower member 40, and a cylindrical boss 66 formed to extend from the center at the other side of the cam member 60 opposite to the cam portion 64. The boss 66 is provided with a through-hole 68 extending along the rotation axis 100 to penetrate through the boss 66 from the cam portion 64. The guide rod 44 fixed to the cam follower member 40 is fitted into the through-hole 68, which penetrates through the boss 66 from the cam portion 64, so that the relative

motion of the guide rod 44 is guided.

The sidewall 62 includes opposite flat walls 70 and opposite arc-shaped walls 72 in the same shape as the sidewall 34 of the housing 30. The cam member 60 constructed as such is fitted into the housing 30 to linearly move along the rotation axis 100 but not to rotate. The cam portion 64 includes a cam surface 74 formed on the side of the cam member facing the cam follower member 40. The cam portion 64 includes two peaks 76a, 76b opposing diametrically with respect to the rotation axis 100, and two valleys 77a, 77b in the form of fixing grooves opposing diametrically with respect to the rotation axis 100. The peak 76a and the valley 77a are connected to each other by a slant surface 79a extending from the peak 76a and a flat section (or linear section) 78a extending from the slat surface 79a to the valley 77a. A slant surface 791a is provided between the peak 76a and the valley 77b. Likewise, a slant surface 79b and a flat section (or linear section) 78b are also provided between the peak 76b and the valley 77b. A slant surface 791b is provided between the peak 76b and the valley 77a.

The cam member 60 is inserted through the open end 38 of the housing 30. At this time, the cam surface 74 is oriented to face the cam follower protrusions 46 of the cam follower member 40. The cam member 60 is snugly inserted into the housing 30 so that its linear motion within the housing 30 along the rotation axis 100 is allowable, but its rotational motion within the housing 30 is limited.

The resilient member 80 urges the cam member 60 against the cam follower member 40. The resilient member 80 is preferably a compression coil spring.

After the cam follower member 40, the cam member 60 and the resilient member 80 are sequentially inserted into the housing 30, the open end of the housing 30 is partially covered by bending the extension protrusions 36 of the housing 30 along bending lines 31.

The cam member, the cam follower member and the resilient member are manufactured by injection molding plastic resin material, and preferably engineering plastic resin material. Further, the cam member and the cam follower member may be manufactured by sintering or cold forging metallic material.

Hereinafter, the operation of the hinge device 20 according to the embodiment of the present invention will be explained with reference to FIGS. 3, 4 (a) to (d) and 5.

When the second case unit is positioned at position P1 in FIG. 5, the radiotelephone 10 is in a completely folded state. The state of the hinge device when the second case unit is disposed at position P1 is shown in FIG. 4 (a), and the position of one of the cam follower protrusions 46 on the cam surface 74 corresponds to position P1 in FIG. 3. In this state, the cam follower protrusion 46 is disposed on the slant surface 791a between the peak 76a and the valley 77b of the cam surface 74. At position P1, the cam member 60 pushes the cam follower member 40 by the force of the resilient member 80. At this time, the cam follower member 40 is subjected to a rotational force by the resilient member 80 and the slant surface 791a. The rotational force causes the second case unit 14 to rotate toward the first case unit 11. That is, the hinge device generates the force, which causes the first case unit 12 and the second case unit 14 to be in close contact with each other, at position P1. Therefore, the radiotelephone 10 is stably maintained in the folded state.

Under this condition, when the case units are moved away from each other in order to open the radiotelephone 10 so that the radiotelephone 10 can be in use, the cam follower protrusion 46 reaches the peak 76a of the cam surface 74. This state is shown in FIG. 4 (b), which corresponds to position P2 in FIGS. 3 and 5. When the case units are moved further away from each other, the cam follower protrusion 46 goes over the peak 76a of the cam surface 74. When the cam follower protrusion 46 goes over the peak 76a of the cam surface 74, the resilient member 80 urges the cam member 60 against the cam follower member 40. Thus, the cam follower protrusion 46 slides down along the slant surface 79a of the cam surface 74 without external force, and stops at position P3 in FIGS. 3 and 5 where the slant surface 79a terminates.

In order to cause the second case unit 14 to move further away from the first case unit from position P3, an external rotational force should be continuously exerted thereon. If the rotational force is not temporarily exerted during the movement of the second case unit 14, the second case unit 14 stops at that position and is maintained at the position by the force of the resilient member 80. At this time, the cam follower

protrusion 46 is disposed at a position on the flat section 78a. This state is shown in FIG. 4 (c) and corresponds to position P4 in FIGS. 3 and 5. When the second case unit 14 disposed at position P4 is further moved away from the first case unit and reaches position P5, the cam follower protrusion 46 is inserted into the valley 77a in the form of the groove of the cam surface 74 and secured therein. FIG. 4 (d) shows the hinge device in this state. That is, the second case unit is maintained in such a stable stationary state at an arbitrary angle between positions P3 and P5.

Now, the operation of the hinge device will be explained in connection with a process of switching the radiotelephone from the unfolded state into the folded state. That is, a process of changing the position of the second case unit from position P5 to position P1 in FIG. 5 will be explained. In the state where the radiotelephone is fully unfolded (position P5 in FIGS. 3 and 5, FIG. 4 (d)), the cam follower protrusion 46 is inserted into and secured in the valley 77a. In this state, a force should be exerted up to position P2 in order to fold the radiotelephone. When a force beyond a predetermined threshold is exerted in the secured state, since the slant surface is provided around the valley 77a, the cam follower protrusion 46 slides up along the slant surface and reaches the flat section 78a. Since the cam follower protrusion 46 passes along the flat section 78a up to position P3, the second case unit can be rotated with a constant rotational force. However, since the cam follower protrusion should pass along the upward slant surface 79a from position P3 to position P2, it is necessary to exert a larger rotational force. After the cam follower protrusion 46 goes over the peak 76a (position P2), it passes along the downward slant surface 791a. Thus, it automatically reaches position P1 without an external rotational force, so that the radiotelephone is in the folded state.

FIGS. 6 to 8 show other embodiments of the cam portion in a deployed state. Referring to FIG. 6, a cam surface 74c is the same as the cam surface 74 shown in FIG. 3 except that it further includes grooves 761c provided at the peaks. Cam follower protrusions 46c can be inserted into and secured in the grooves 761c. The cam follower protrusions 46c move between position P1 and position P5 in the same manner as the embodiment shown in FIG. 3. When the cam follower protrusions 46c are

inserted into the grooves 761c at the peaks (position P2), the unfolded or opened state of the radiotelephone corresponds to position P2 in FIG. 5. The operations at the other positions are the same as the embodiment shown in FIG. 3. Referring to FIG. 7, a cam surface 74d is the same as the cam surface 74 shown in FIG. 3 except that it further includes grooves 782d provided at the beginnings of linear sections 78d. Cam follower protrusions 46d can be inserted into and secured in the grooves 782d. The cam follower protrusions 46d move between position P1 and position P5 in the same manner as the embodiment shown in FIG. 3. When the cam follower protrusions 46d are inserted into the grooves 782d (position P3), the unfolded or opened state of the radiotelephone corresponds to position P3 in FIG. 5. The operations at the other positions are the same as the embodiment shown in FIG. 3. Referring to FIG. 8, a cam surface 74e is the same as the cam surface 74 shown in FIG. 3 except that it further includes a plurality of grooves 785e provided in the linear section 78e. Cam follower protrusions 46e can be inserted into and secured in each of the plurality of grooves 785e. The cam follower protrusions 46e moves between position P1 and position P5 in the same manner as the embodiment shown in FIG. 3. When each of the cam follower protrusions 46e is inserted into any one of the plurality of grooves 785e (position P4), the unfolded or opened state of the radiotelephone corresponds to position P4 in FIG. 5. The operations at the other positions are the same as the embodiment shown in FIG. 3.

Although the present invention has been described in connection with the preferred embodiments, it will be understood that various modifications and changes can be made thereto without departing from the scope and spirit of the present invention.

CLAIMS

1. A hinge device for coupling a first unit and a second unit which can be relatively rotated with respect to each other to a folded or unfolded position, comprising:

a cam member with a cam;

a cam follower member provided with cam followers interacting with the cam of the cam member; and

a resilient member for exerting a force on any one of the cam member and the cam follower member so that the cam followers of the cam follower member can interact with the cam of the cam member,

wherein one of the cam member and the cam follower member is mounted in the first unit to linearly move with respect to the first unit and the other is coupled to the second unit to rotate about a rotation axis with respect to the linearly moving member,

wherein the cam of the cam member includes a peak for causing the linearly moving member of the cam member and the cam follower member to be moved farthest away from the other rotating member, two slant surfaces sloping downward from and on both sides of each of the peak, and a linear section that is connected to one of the two slant surfaces and holds the linearly moving member in a predetermined position.

2. The hinge device as claimed in claim 1, wherein the end of the linear section is provided with a groove forming a valley into which the cam follower member is inserted.

3. The hinge device as claimed in claim 1, further comprising a housing that is fixed to the first unit and contains the linearly moving member therein.

4. The hinge device as claimed in claim 1, wherein a guide rod extending along the rotation axis is fixed to one of the cam member and the cam follower member, and a guide hole into which the guide rod is inserted is formed on the other of the cam

member and the cam follower member, thereby guiding the relative motion between the cam member and the cam follower member.

5 5. The hinge device as claimed in claim 3, wherein the rotating member of the cam member and the cam follower member includes an extension shaft protruding toward the exterior of the housing, and the hinge device further comprises a coupling member coupled to the extension shaft and the second unit.

10 6. The hinge device as claimed in claim 1 or 2, wherein the peak are provided with grooves into which the cam follower member can be inserted.

7. The hinge device as claimed in claim 1 or 2, wherein a groove into which the cam follower member can be inserted is provided at a portion where the one of the slant surfaces and the linear section meet each other.

15 8. The hinge device as claimed in claim 1 or 2, wherein the linear section is provided with a plurality of grooves into which the cam follower member can be inserted.

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FIG. 1

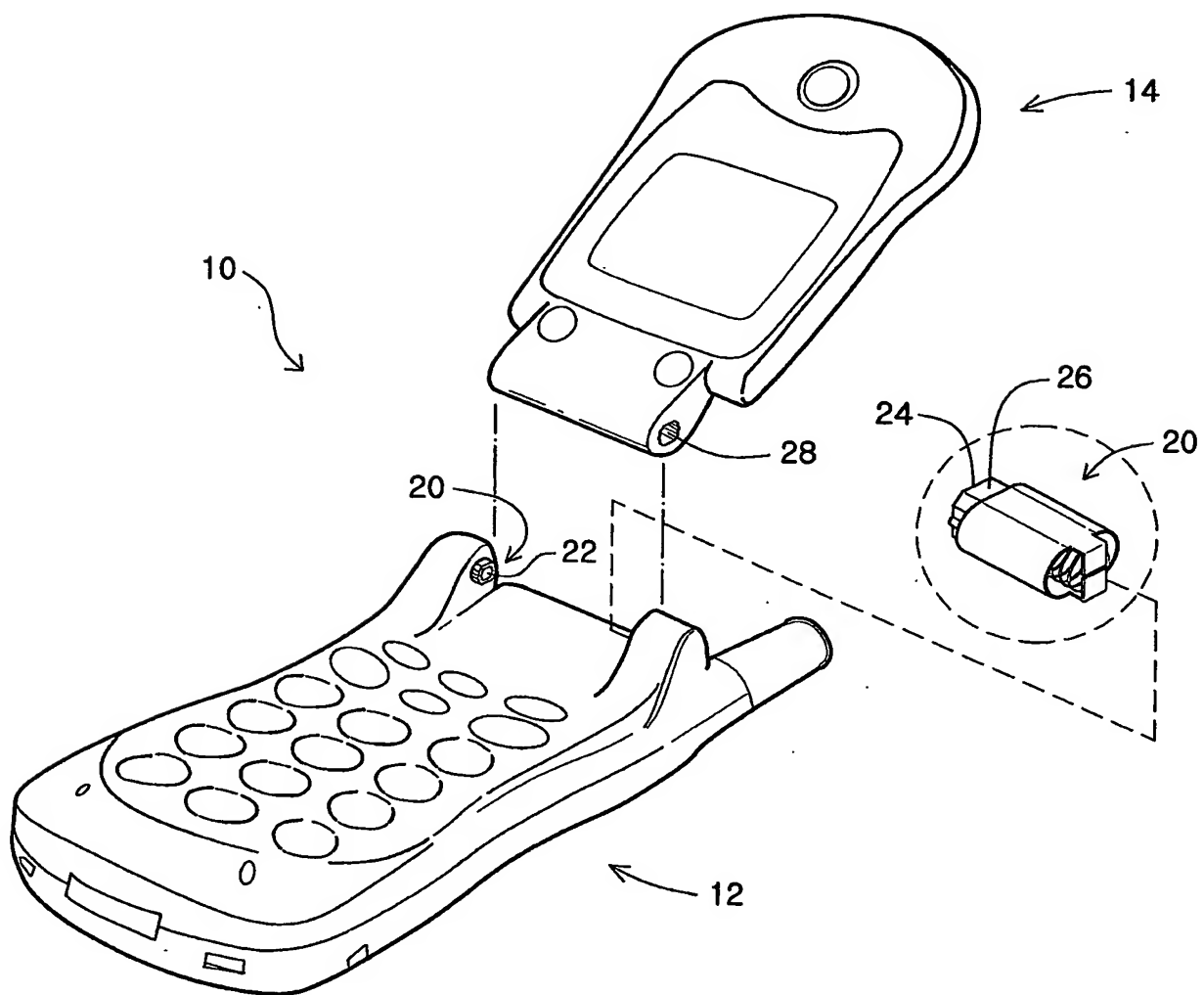
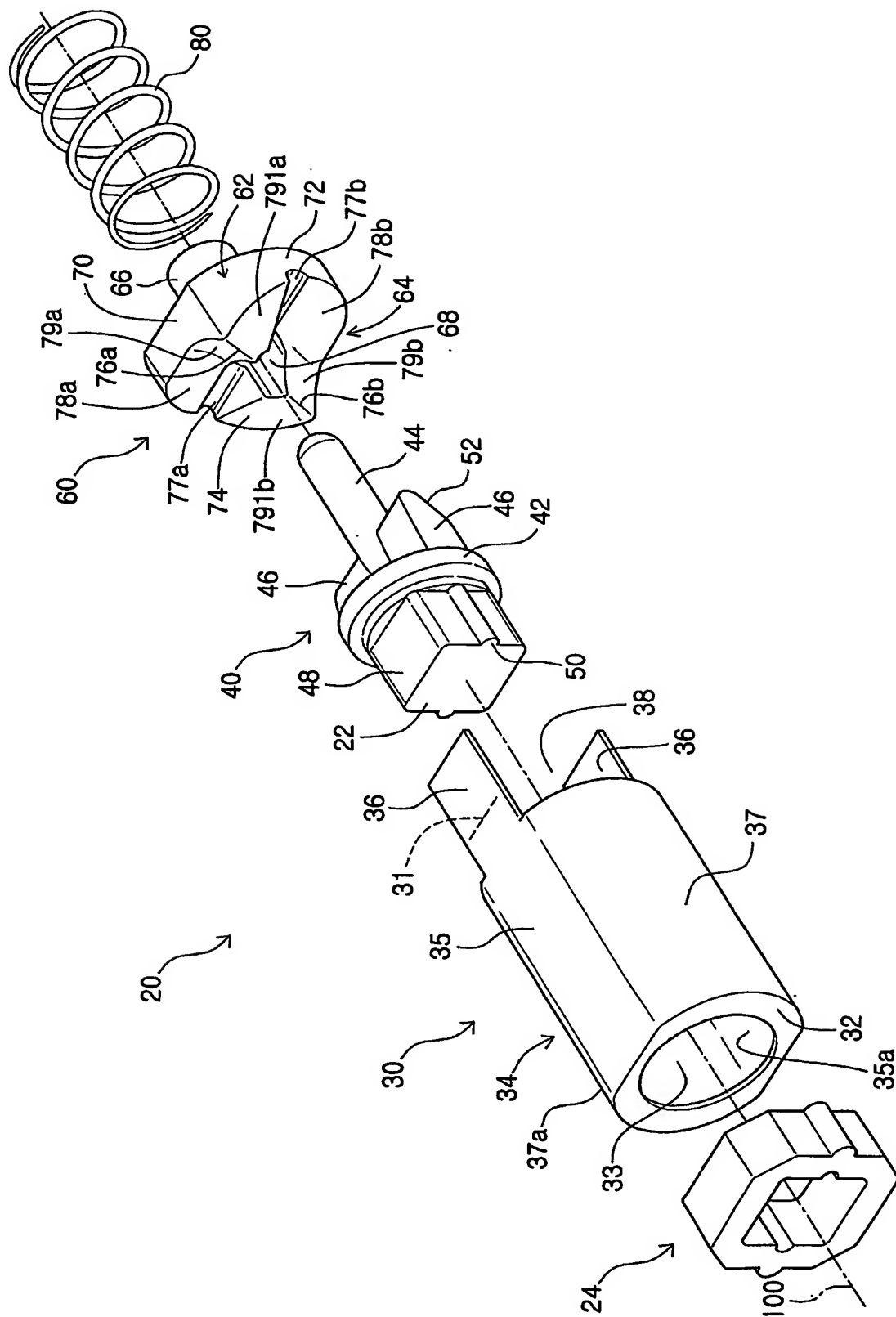
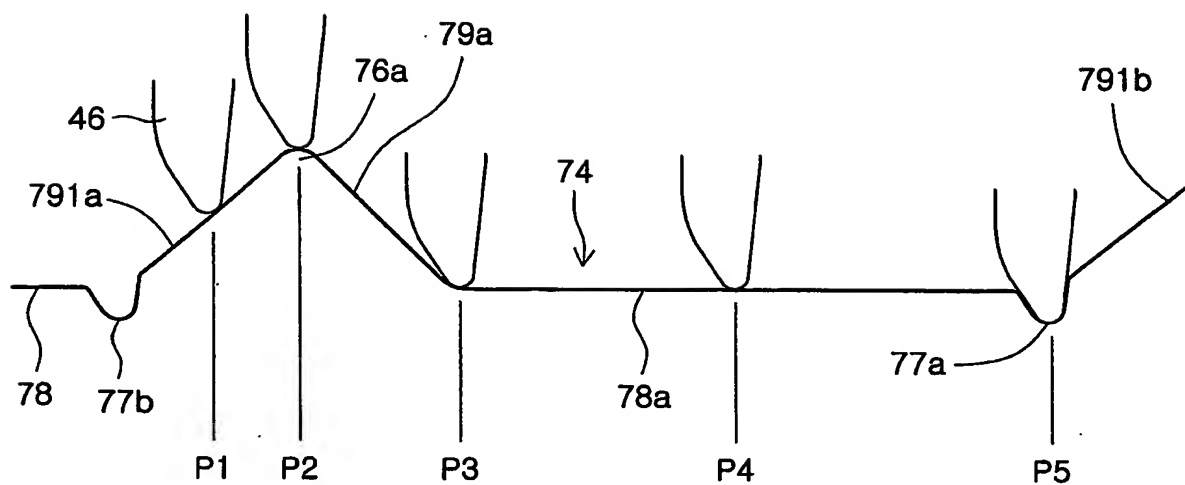


FIG. 2



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FIG. 3



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FIG. 4

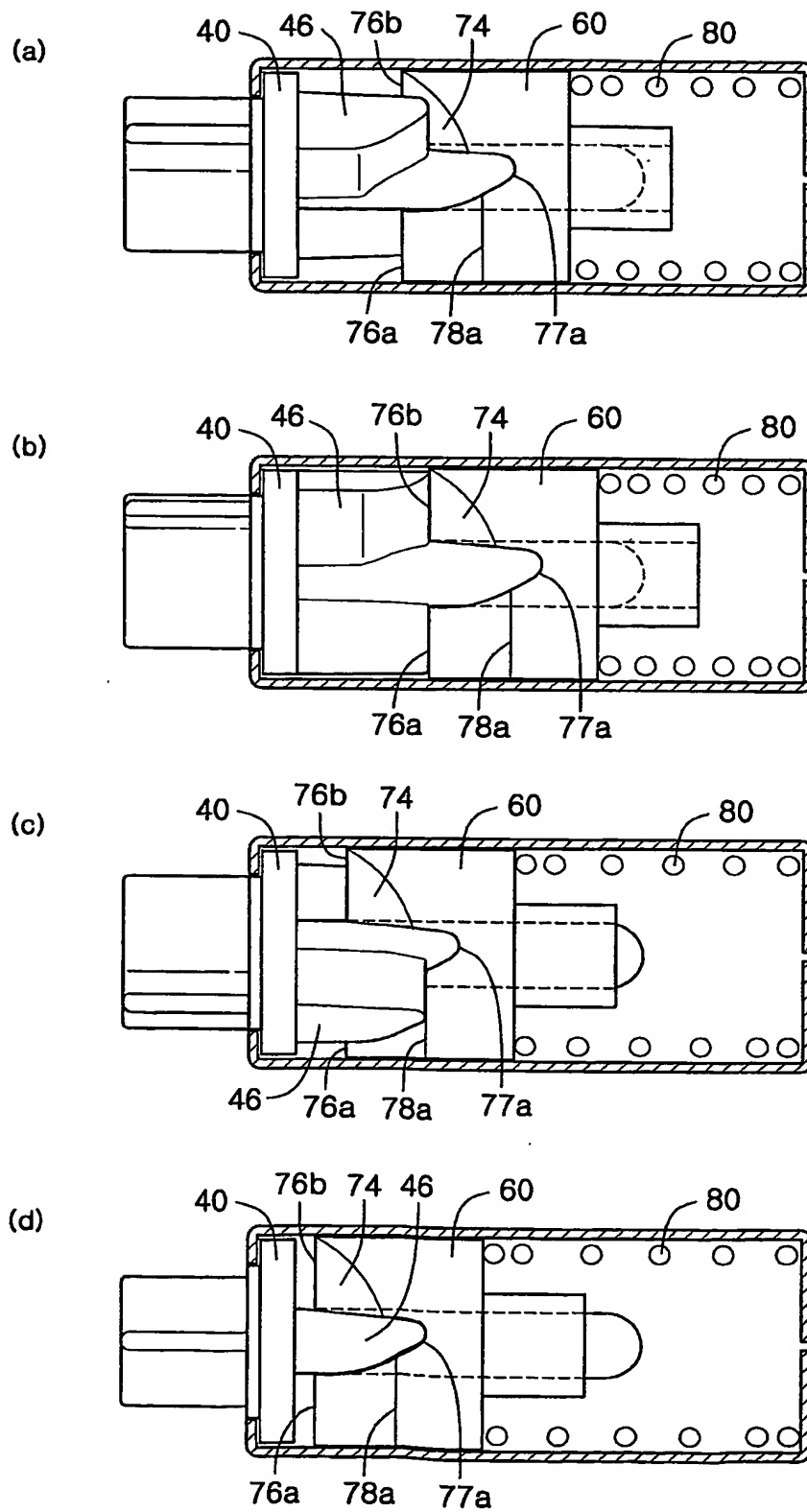


FIG. 5

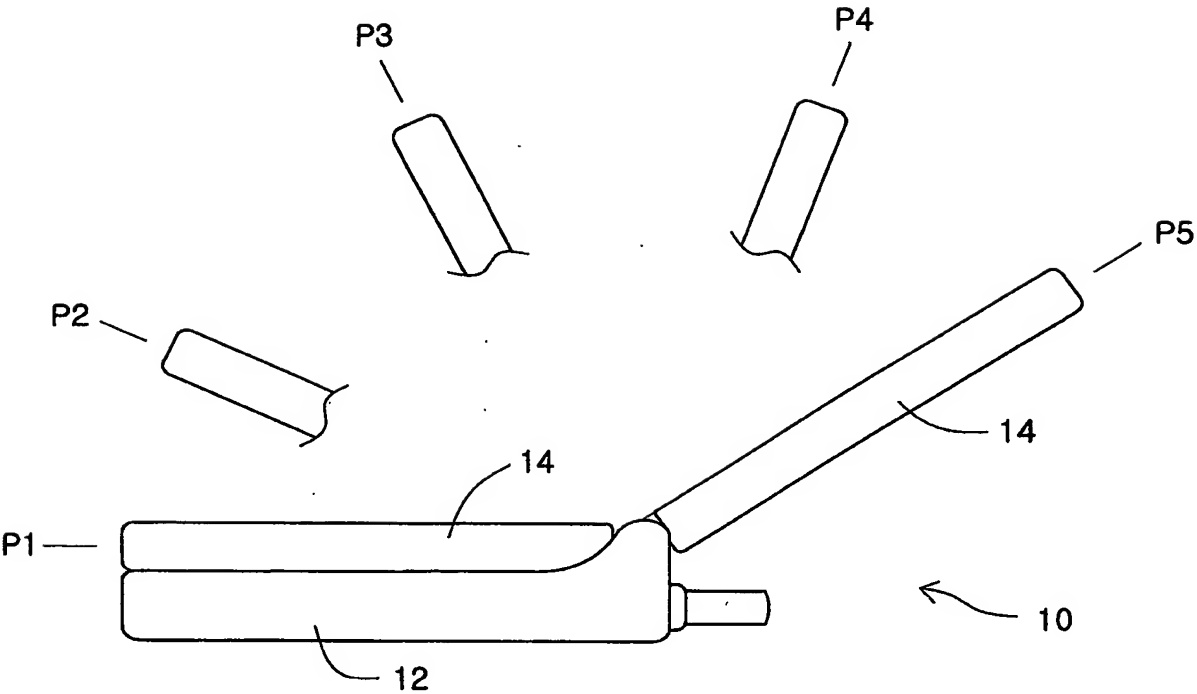


FIG. 6

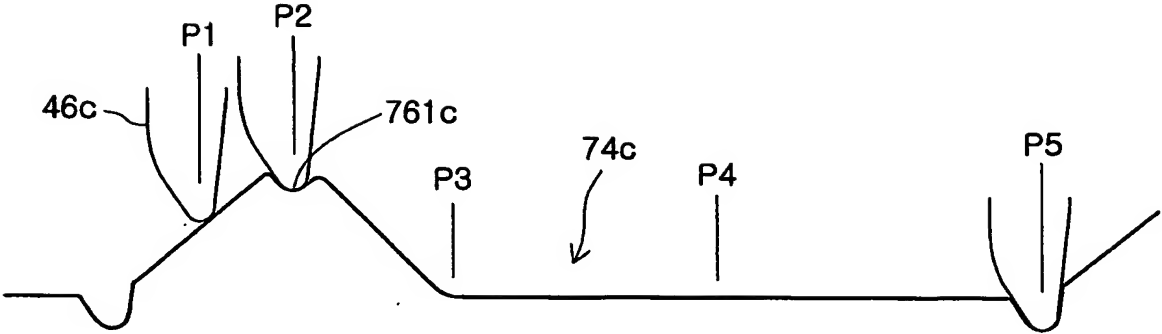


FIG. 7

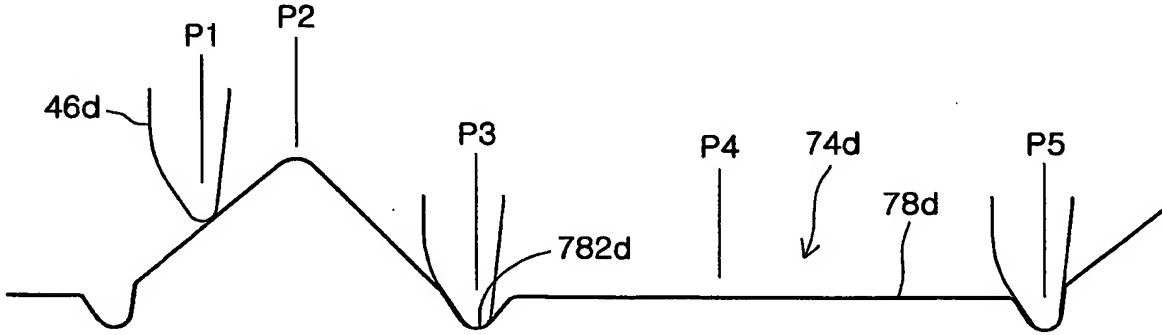
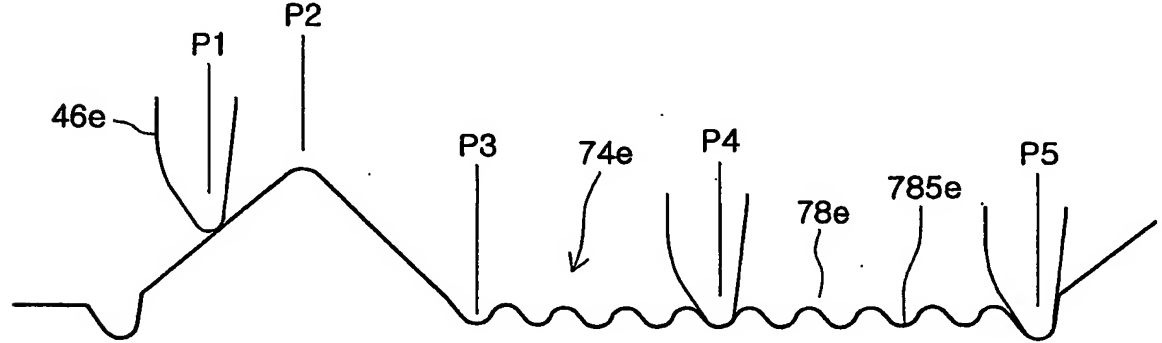




FIG. 8



INTERNATIONAL SEARCH REPORT

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| A. CLASSIFICATION OF SUBJECT MATTER IPC7 H04B 1/38 According to International Patent Classification (IPC) or to both national classification and IPC | | |
|--|---|---|
| B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 H04B 1/38, H04M 1/02, E05D11/10 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean Patents and applications for inventions since 1975 Korean Utility models and applications for Utility models since 1975 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) | | |
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| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| E,X | KR 20-263833 Y(Hyun-Ho Choi) 09 FEBRUARY 2002(09.02.2002) See the whole Document | 1-8 |
| A | JP 2001-1858368 A(STRAWBERRY CORPORATION:KK) 06 July 2001(06.07.2001) See the whole Document | 1 |
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